

SECTION 05093

WELDING PRESSURE PIPING
09/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A	(1996) Recommended Practice SNT-TC-1A
ASNT Q+A Bk A	(1996) Question and Answer Book A: Radiographic Test Method; Levels I, II, III (Supplement to Recommended Practice SNT-TC-1A)
ASNT RP SNT-TC-1A Bk B	(1994) Question and Answers Levels I, II, and III Magnetic Particle Method Book B (Supplement to RP SNT-TC-1A)
ASNT Q+A Bk C	(1994) Question and Answer Book C: Ultrasonic Testing Method; Levels I, II, III (Supplement to RP SNT-TC-1A)
ASNT Q+A Bk D	(1996) Question and Answer Book D: Liquid Penetrant Testing Method; Levels I, II, III (Supplement to RP SNT-TC-1A)

ASME INTERNATIONAL (ASME)

ASME B31.1	(1998) Power Piping
ASME B31.3	(1999) Process Piping
ASME B31.4	(1992; B31.4a) Liquid Transportation Systems for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia, and Alcohols
ASME B31.5	(1992; B31.5a) Refrigeration Piping
ASME B31.8	(1995) Gas Transmission and Distribution Piping Systems
ASME BPV I	(1998) Boiler and Pressure Vessel Code; Section I, Power Boilers
ASME BPV II Pt C	(1998) Boiler and Pressure Vessel Code; Section II, Materials, Part C - Specifications for Welding Rods, Electrodes and Filler Metals

ASME BPV V (1998) Boiler and Pressure Vessel Code;
Section V, Nondestructive Examination

ASME BPV IX (1998) Boiler and Pressure Vessel Code;
Section IX, Welding and Brazing
Qualifications

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4 (1998) Standard Symbols for Welding,
Brazing and Nondestructive Examination

AWS A3.0 (1994) Standard Welding Terms and
Definitions

AWS B2.1 (1998) Welding Procedure and Performance
Qualification

AWS QC1 (1996) AWS Certification of Welding
Inspectors

AWS Z49.1 (1999) Safety in Welding and Cutting and
Allied Processes

1.2 DEFINITIONS

Definitions shall be in accordance with AWS A3.0.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Pressure Piping; G|WA

Detail drawings showing location, length, and type of welds; and indicating postweld heat treatment and NDE as required.

SD-03 Product Data

Qualifications; G|WA

Welding procedure qualification.

Welding Operations; FIO

Detailed procedures which define methods of compliance to contract drawings and specifications. Inspection and material procurement records. System and material testing and certification records. Written records and drawings indicating location of welds made by each welder or welding operator.

SD-07 Certificates

Qualifications; G|WA

Welder and welding operator performance qualification certificates. Welding inspectors and NDE personnel certificates. Qualifications of testing laboratory or the Contractor's quality assurance organization.

1.4 GENERAL REQUIREMENTS

This section covers the welding of pressure piping systems. Deviations from applicable codes, approved procedures, and approved detail drawings will not be permitted without prior written approval. Materials or components with welds made offsite will not be accepted if the welding does not conform to the requirements of this specification, unless otherwise specified. Procedures shall be developed by the Contractor for welding all metals included in the work. Welding shall not be started until welding procedures, welders, and welding operators have been qualified. Qualification testing shall be performed by an approved testing laboratory, or by the Contractor if approved by the Contracting Officer. Costs of such testing shall be borne by the Contractor. The Contracting Officer shall be notified at least 24 hours in advance of the time and place of the tests. When practicable, the qualification tests shall be performed at or near the worksite. The Contractor shall maintain current records of the test results obtained in the welding procedure, welding operator, welder performance qualifications, and nondestructive examination (NDE) procedures readily available at the site for examination by the Contracting Officer. The procedures for making transition welds between different materials or between plates or pipes of different wall thicknesses shall be qualified. ASME B31.1, ASME B31.3, and ASME B31.8 requirements for branch connections may be used in lieu of detailed designs. Unless otherwise specified, the choice of welding process shall be the responsibility of the Contractor.

1.5 PERFORMANCE

The Contractor shall be responsible for the quality of all joint preparation, welding, and examination. All materials used in the welding operations shall be clearly identified and recorded. The inspection and testing defined in this specification are minimum requirements. Additional inspection and testing shall be the responsibility of the Contractor when he deems it necessary to achieve the quality required.

1.6 QUALIFICATIONS

Welding procedures, welders, and welding operators previously qualified by test may be accepted for the work without requalification, provided that all of the following conditions are fulfilled:

- a. Copies of the welding procedures, the procedure qualification test records, and the welder and welding operator performance qualification test records are submitted and approved in accordance with paragraph SUBMITTALS.
- b. Testing was performed by an approved testing laboratory or technical consultant or by the Contractor's approved quality assurance organization.
- c. The welding procedures, welders, and welding operators were qualified in accordance with ASME BPV IX, or AWS B2.1, AR-2 level;

and base materials, filler materials, electrodes, equipment, and processes conformed to the applicable requirements of this specification.

- d. The requirements of paragraph "Renewal of Qualification" below are met and records showing name of employer and period of employment using the process for which qualified are submitted as evidence of conformance.

1.6.1 Welding Procedures Qualification

The Contractor shall record in detail and shall qualify the Welding Procedure Specifications for every proposed welding procedure. Qualification for each welding procedure shall conform to the requirements of ASME B31.1, ASME B31.3, and ASME B31.8, and to this specification. The welding procedures shall specify end preparation for butt welds including cleaning, alignment, and root openings. Preheat, interpass temperature control, and postheat treatment of welds shall be as required by approved welding procedures, unless otherwise indicated or specified. The type of backing rings or consumable inserts, if used, shall be described and if they are to be removed, the removal process shall be described. Copies of the welding procedure specifications and procedure qualification test results for each type of welding required shall be submitted in accordance with paragraph SUBMITTALS. Approval of any procedure does not relieve the Contractor of the sole responsibility for producing acceptable welds. Welding procedures shall be identified individually and shall be referenced on the detail drawings or keyed to the contract drawings.

1.6.2 Welder and Welding Operator Performance

Each welder and welding operator assigned to work shall be qualified in accordance with ASME B31.1, ASME B31.3, and ASME B31.8.

1.6.2.1 Certification

Before assigning welders or welding operators to the work, the Contractor shall provide the Contracting Officer with their names together with certification that each individual is performance-qualified as specified. The certification shall state the type of welding and positions for which each is qualified, the code and procedure under which each is qualified, date qualified, and the firm and individual certifying the qualification tests.

1.6.2.2 Identification

Each particular weld shall be identified with the personal number, letter, or symbol assigned to each welder or welding operator. To identify welds, written records indicating the location of welds made by each welder or welding operator shall be submitted, and each welder or welding operator shall apply the personal mark adjacent to the welds using a rubber stamp or felt-tipped marker with permanent, weatherproof ink or other methods approved by the Contracting Officer that do not deform the metal. For seam welds, identification marks shall be placed adjacent to the welds at 3 foot intervals. Identification by die stamps or electric etchers will not be allowed.

1.6.2.3 Renewal of Qualification

Requalification of a welder or welding operator shall be required under any

of the following conditions:

- a. When a welder or welding operator has not used the specific welding process for a period of 3 months; the period may be extended to 6 months if the welder or welding operator has been employed on some other welding process.
- b. When a welder or welding operator has not welded with any process during a period of 3 months, all the personal qualifications shall be considered expired, including any extended by virtue of a., above.
- c. There is specific reason to question the person's ability to make welds that will meet the requirements of the specifications.
- d. The welder or welding operator was qualified by an employer, other than those firms performing work under this contract, and a qualification test has not been taken within the preceding 12 months.
- e. Renewal of qualification for a specific welding process under conditions a., b., and d., above, needs to be made on only a single test joint or pipe of any thickness, position, or material to reestablish the welder's or welding operator's qualification for any thickness, position, or material covered under previous qualification.

1.6.3 Inspection and NDE Personnel

All inspection and NDE personnel shall be qualified in accordance with the following requirements.

1.6.3.1 Inspector Certification

Welding inspectors shall be qualified in accordance with AWS QC1.

1.6.3.2 NDE Personnel

NDE personnel shall be certified, and a written procedure for the control and administration of NDE personnel training, examination, and certification shall be established. The procedures shall be based on appropriate specific and general guidelines of training and experience recommended by ASNT RP SNT-TC-1A.

1.7 DELIVERY, STORAGE, AND HANDLING

All filler metals, electrodes, fluxes, and other welding materials shall be delivered to the site in manufacturers' original packages and stored in a dry space until used. Packages shall be properly labeled and designed to give maximum protection from moisture and to insure safe handling.

1.7.1 Material Control

Materials shall be stored in a controlled access and clean, dry area that is weathertight and is maintained at a temperature recommended by the manufacturer. The materials shall not be in contact with the floor and shall be stored on wooden pallets or cribbing.

1.7.1.1 Damaged Containers

Low-hydrogen steel electrodes shall be stored in their sealed shipping container. If the seal is damaged during shipment or storage, and the damage is not immediately detected, the covered electrodes in that container shall be rebaked in accordance with the manufacturer's instructions prior to issuance or shall be discarded. If a container is damaged in storage and the damage is witnessed, the electrodes from that container shall be immediately placed in a storage oven. The storage oven temperature shall be as recommended by the manufacturer or the welding material specification.

1.7.1.2 Partial Issues

When a container of covered electrodes is opened and only a portion of the content is issued, the remaining portion shall, within 1/2 hour, be placed in a storage oven.

1.7.2 Damaged Materials

Materials which are damaged shall be discarded. Covered electrodes which are oil or water-soaked, dirty, or on which the flux has separated from the wire shall be discarded.

1.8 SYMBOLS

Symbols shall be in accordance with AWS A2.4.

1.9 SAFETY

Safety precautions shall conform to AWS Z49.1.

PART 2 PRODUCTS

2.1 WELDING MATERIALS

Welding materials shall comply with ASME BPV II Pt C. Welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator using qualified welding procedures.

PART 3 EXECUTION

3.1 WELDING OPERATIONS

Welding shall be performed in accordance with qualified procedures using qualified welders and welding operators. Welding shall not be done when the quality of the completed weld could be impaired by the prevailing working or weather conditions. The Contracting Officer shall determine when weather or working conditions are unsuitable for welding.

3.1.1 Base Metal Preparation

Oxy-fuel cutting shall not be used on austenitic stainless steel or nonferrous materials.

3.1.2 Weld Joint Fit-Up

Parts that are to be joined by welding shall be fitted, aligned, and retained in position during the welding operation by the use of bars,

jacks, clamps, or other mechanical fixtures. Welded temporary attachments shall not be used except when it is impractical to use mechanical fixtures.

When temporary attachments are used, they shall be the same material as the base metal, and shall be completely removed by grinding or thermal cutting after the welding operation is completed. If thermal cutting is used, the attachment shall be cut to not less than 1/4 inch from the member and the balance removed by grinding. After the temporary attachment has been removed, the area shall be visually examined.

3.1.3 Preheat and Interpass Temperatures

Preheat temperatures shall meet the requirements specified by ASME B31.1, ASME B31.3, and ASME B31.8. However, in no case shall the preheat be below 50 degrees F for ferritic steel or austenitic stainless steel, or 32 degrees F for nonferrous alloys. The maximum interpass temperatures shall not exceed 300 degrees F for austenitic stainless steels, nickel alloys, and copper alloys; and 500 degrees F for carbon steels. Preheat techniques shall be such as to ensure that the full thickness of the weld joint preparation and/or adjacent base material, at least 3 inches in all directions, is at the specified temperature. Preheating by induction or resistance methods is preferred. When flame heating is used, only a neutral flame shall be employed. Oxy-fuel heating shall not be used on austenitic stainless steel or nickel-alloy materials; however, air-fuel heating is acceptable if controlled to insure that the surface temperature does not exceed 150 degrees F. Interpass temperatures shall be checked on the surface of the component within 1 inch of the weld groove and at the starting location of the next weld pass, and for a distance of about 6 inches ahead of the weld, but not on the area to be welded.

3.1.4 Production Welding Instructions

- a. Welding shall not be done when the ambient temperature is lower than 0 degree F.
- b. Welding is not permitted on surfaces that are wet or covered with ice, when snow or rain is falling on the surfaces to be welded, or during periods of high winds, unless the welders and the work are properly protected.
- c. Gases for purging and shielding shall be welding grade and shall have a dew point of minus 40 degrees F or lower.
- d. Back purges are required for austenitic stainless steels and nonferrous alloys welded from one side and shall be set up such that the flow of gas from the inlet to the outlet orifice passes across the area to be welded. The oxygen content of the gas exiting from the purge vent shall be less than 2 percent prior to welding.
- e. The purge on groove welds shall be maintained for at least three layers or 3/16 inch.
- f. Removable purge dam materials shall be made of expandable or flexible plugs, such as plexiglass, plywood (which shall be dry when used), etc. Wood dams shall be kiln-dried quality. Nonremovable purge dams and purge dam adhesives shall be made of water soluble materials. Purge dams shall not be made of polyvinyl alcohol.

- g. Any welding process which requires the use of external gas shielding shall not be done in a draft or wind unless the weld area is protected by a shelter. This shelter shall be of material and shape appropriate to reduce wind velocity in the vicinity of the weld to a maximum of 5 mph (440 fpm).
- h. Welding of low-alloy and hardenable high-alloy steels may be interrupted provided a minimum of at least 3/8 inch thickness of weld deposit or 25 percent of the weld groove is filled, whichever is greater, and the preheat temperature is maintained during the time that welding is interrupted. If the temperature falls below the minimum preheat temperature before all welding has been completed on a joint, or, where required, before post weld heat treatment, a liquid penetrant or magnetic particle examination shall be performed to insure sound deposited metal before reheating. Welding of other materials may be interrupted without restriction provided a visual inspection is performed before welding is resumed.
- i. Tack welds to be incorporated in the final welds shall have their ends tapered by grinding or welding technique. Tack welds that are cracked or defective shall be removed and the groove shall be retacked prior to welding. Temporary tack welds shall be removed, the surface ground smooth, and visually inspected. For low-alloy and hardenable high-alloy steels, the area shall be magnetic particle examination inspected.
- j. When joining ferritic steel pressure piping components to austenitic stainless steel pressure piping components and postweld heat treatment is required, the following requirements apply:
 - (1) The weld-end preps of ferritic steel components, which are to be welded to austenitic stainless steel, shall be buttered with one of the following weld filler metals and shall conform to the specified requirements:

ASME BPV II Pt C, SFA 5.14, Classification ERNiCr-3.

ASME BPV II Pt C, SFA 5.11, Classification ENiCrFe-2.
 - (2) The ferritic steel weld-end prep shall be buttered, receive a postweld heat treatment as required by ASME B31.1, ASME B31.3, ASME B31.8 and then be machined with the applicable weld-end preparation. After machining, the buttered layer shall be a minimum of 1/4 inch thick.
 - (3) Pressure piping transition joints shall be completed using ERNiCr-3 or ENiCrFe-2 weld filler metals. No further postweld heat treatment shall be performed.
- k. When joining ferritic steel pressure piping components to austenitic stainless steel pressure piping components and postweld heat treatment is not required, prepare and weld the joint using either ERNiCr-3 or ENiCrFe-2 filler metals. For service temperatures of 200 degrees F or less, stainless filler metal 309 ASME BPV II Pt C, SFA 5.4 or 5.9 is permissible in lieu of the nickel-based alloys.
- l. Grinding of completed welds is to be performed only to the extent

required for NDE, including any inservice examination, and to provide weld reinforcement within the requirements of ASME B31.1, ASME B31.3, and ASME B31.8. If the surface of the weld requires grinding, reducing the weld or base material below the minimum required thickness shall be avoided. Minimum weld external reinforcement shall be flush between external surfaces.

3.1.5 Postweld Heat Treatment

Postweld heat treatment shall be performed in accordance with ASME B31.1, ASME B31.3, and ASME B31.8. Temperatures for local postweld heat treatment shall be measured continuously by thermocouples in contact with the weldment.

Postweld heat treatment of low-alloy steels, when required, shall be performed immediately upon completion of welding and prior to the temperature of the weld falling below the preheat temperature. However, postweld heat treatment may be postponed after the completion of the weld, if, immediately after the weld is completed, it is maintained at a minimum temperature of 300 degrees F or the preheat temperature, whichever is greater, for 2 hours per inch of weld thickness.

For low-alloy steels, the cooling rates shall be such that temper embrittlement is avoided.

3.2 EXAMINATIONS, INSPECTIONS, AND TESTS

Visual and NDE shall be performed by the Contractor to detect surface and internal discontinuities in completed welds. The services of a qualified commercial inspection or testing laboratory or technical consultant, approved by the Contracting Officer, shall be employed by the Contractor. All tack welds, weld passes, and completed welds shall be visually inspected. In addition, magnetic particle or liquid penetrant examination shall be performed on root passes. Radiographic, Liquid penetrant, Magnetic particle, or Ultrasonic examination shall be required as indicated in TABLE I. When inspection and testing indicates defects in a weld joint, the weld shall be repaired by a qualified welder in accordance with paragraph CORRECTIONS AND REPAIRS.

TABLE I. MANDATORY MINIMUM NONDESTRUCTIVE EXAMINATIONS

Type Weld	Piping Service Conditions and Nondestructive Test		
	Temperatures over 750 degrees F and at all pressures.	Temperatures between 350 degrees F and 750 degrees F inclusive and at pressures above 1,025 psig.	All others.
Butt Welds (Girth and Longitudinal)	RT for NPS over 2 inch MT or PT for NPS 2 inches and less.	RT for over 2 inch NPS with thickness over 3/4 inch. Visual for all sizes with thickness 3/4 inch or less.	Visual for all sizes and thicknesses.

TABLE I. MANDATORY MINIMUM NONDESTRUCTIVE EXAMINATIONS

Type Weld	Piping Service Conditions and Nondestructive Test		
Welded Branch Connections (Size indicated is branch size) (See Note 7)	RT for NPS over 4 inch MT or PT for NPS 4 inches and less.	RT for branch over 4 inch NPS and thickness of branch over 3/4 inch. Visual for all sizes with branch thickness 3/4 inch or less.	Visual for all sizes and thicknesses.
Fillet, Socket Attachment and Seal Welds	PT or MT for all sizes and thicknesses.	Visual for all sizes and thicknesses.	Visual for all sizes and thicknesses.

NOTES TO TABLE I

- (1) All welds must be given a visual examination in addition to type of specific nondestructive examination specified.
- (2) NPS - nominal pipe size.
- (3) RT - Radiographic examination; MT - magnetic particle examination; PT - liquid penetrant examination.
- (4) RT of branch welds shall be performed before any nonintegral reinforcing material is applied.
- (5) The thickness of butt welds is defined as the thicker of the two abutting ends after end preparation.
- (6) Temperatures and pressures shown are design.
- (7) In lieu of radiography of welded branch connections when required above, liquid penetrant or magnetic particle examination is acceptable and, when used, shall be performed at the lesser of one half of the weld thickness or each 1/2 inch of weld thickness and all accessible final weld surfaces.
- (8) For nondestructive examination of the pressure retaining component, refer to the standards listed in applicable code or the manufacturing specifications.
- (9) Fillet welds not exceeding 1/4 inch throat thickness which are used for the permanent attachment of nonpressure retaining parts are exempt from the PT or MT requirements of the above table.

3.2.1 Random NDE Testing

When random radiographic, liquid penetrant, magnetic particle or ultrasonic examination is required, the Contractor shall test a minimum of 5 percent of the total length or number of piping welds. The welds inspected shall be selected randomly, but the selection shall include an examination of

welds made by each welding operator or welder. If the random testing reveals that any welds fail to meet minimum quality requirements, an additional 10 percent of the welds in that same group shall be inspected. If all of the additional welds inspected meet the quality requirements, the entire group of welds represented shall be accepted and the defective welds shall be repaired. If any of the additional welds inspected also fail to meet the quality requirements, that entire group of welds shall be rejected. The rejected welds shall be removed and rewelded, or the rejected welds shall be 100 percent inspected and all defective weld areas removed and rewelded.

3.2.2 Visual Inspection

Weld joints shall be inspected visually as follows:

- a. Before welding - for compliance with requirements for joint preparation, placement of backing rings or consumable inserts, alignment and fit-up, and cleanliness.
- b. During welding - for cracks and conformance to the qualified welding procedure.
- c. After welding - for cracks, contour and finish, bead reinforcement, undercutting, overlap, and size of fillet welds.

3.2.3 NDE Testing

NDE shall be in accordance with written procedures. Procedures for radiographic, liquid penetrant, magnetic particle or ultrasonic tests and methods shall conform to ASME BPV V. The approved procedure shall be demonstrated to the satisfaction of the Contracting Officer. In addition to the information required in ASME BPV V, the written procedures shall include the timing of the NDE in relation to the welding operations and safety precautions.

3.2.4 Inspection and Tests by the Government

The Government will perform inspection and supplemental nondestructive or destructive tests as deemed necessary. The cost of supplemental NDE will be borne by the Government. The correction and repair of defects and the reexamination of weld repairs shall be performed by the Contractor at no additional cost to the Government. Inspection and tests will be performed as required for visual inspection and NDE, except that destructive tests may be required also. When destructive tests are ordered by the Contracting Officer and performed by the Contractor and the specimens or other supplemental examinations indicate that the materials and workmanship do not conform to the contract requirements, the cost of the tests, corrections, and repairs shall be borne by the Contractor. When the specimens or other supplemental examinations of destructive tests indicate that materials or workmanship do conform to the specification requirements, the cost of the tests and repairs will be borne by the Government. When destructive tests are made, repairs shall be made by qualified welders or welding operators using welding procedures which will develop the full strength of the members cut. Welding shall be subject to inspection and tests in the mill, shop, and field. When materials or workmanship do not conform to the specification requirements, the work may be rejected at any time before final acceptance of the system containing the weldment.

3.3 ACCEPTANCE STANDARDS

3.3.1 Visual

The following indications are unacceptable:

- a. Cracks.
- b. Undercut on surface which is greater than 1/32 inch deep.
- c. Weld reinforcement greater than 3/16 inch.
- d. Lack of fusion on surface.
- e. Incomplete penetration (applies only when inside surface is readily accessible).
- f. Convexity of fillet weld surface greater than 10 percent of longest leg plus 0.03 inch.
- g. Concavity in groove welds.
- h. Concavity in fillet welds greater than 1/16 inch.
- i. Fillet weld size less than indicated or greater than 1-1/4 times the minimum indicated fillet leg length.

3.3.2 Magnetic Particle Examination

The following relevant indications are unacceptable:

- a. Any cracks and linear indications.
- b. Rounded indications with dimensions greater than 3/16 inch.
- c. Four or more rounded indications in a line separated by 1/16 inch or less edge-to-edge.
- d. Ten or more rounded indications in any 6 square inches of surface with the major dimension of this area not to exceed 6 inches with the area taken in the most unfavorable location relative to the indications being evaluated.

3.3.3 Liquid Penetrant Examination

Indications with major dimensions greater than 1/16 of an inch shall be considered relevant. The following relevant indications are unacceptable:

- a. Any cracks or linear indications.
- b. Rounded indications with dimensions greater than 3/16 inch.
- c. Four or more rounded indications in a line separated by 1/16 inch or less edge-to-edge.
- d. Ten or more rounded indications in any 6 square inches of surface with the major dimension of this area not to exceed 6 inches with the area taken in the most unfavorable location relative to the indications being evaluated.

3.3.4 Radiography

Welds that are shown by radiography to have any of the following discontinuities are unacceptable:

- a. Porosity in excess of that shown as acceptable in ASME BPV I, Appendix A-250.
- b. Any type of crack or zone of incomplete fusion or penetration.
- c. Any other elongated indication which has a length greater than:
 - (1) $1/4$ inch for t up to $3/4$ inch inclusive, where t is the thickness of the thinner portion of the weld.
 - (2) $1/3 t$ for t from $3/4$ inch to $2-1/4$ inch, inclusive.
 - (3) $3/4$ inch for t over $2-1/4$ inch.
- d. Any group of indications in line that have an aggregate length greater than t in a length of $12t$, except where the distance between the successive indications exceeds $6L$ where L is the longest indication in the group.

Where t pertains to the thickness of the weld being examined; if a weld joins two members having different thickness at the weld, t is the thinner of these two thicknesses.

3.3.5 Ultrasonic Examination

Linear-type discontinuities are unacceptable if the amplitude exceeds the reference level and discontinuities have lengths which exceed the following:

- a. $1/4$ inch for t up to $3/4$ inch.
- b. $1/3$ inch for t from $3/4$ to $2-1/4$ inch.
- c. $3/4$ inch for t over $2-1/4$ inch.

Where t is the thickness of the weld being examined; if the weld joins two members having different thicknesses at the weld, t is the thinner of these two thicknesses. Where discontinuities are interpreted to be cracks, lack of fusion, and incomplete penetration, they are unacceptable regardless of length.

3.4 CORRECTIONS AND REPAIRS

Defects shall be removed and repaired as specified in ASME B31.1, ASME B31.3, and ASME B31.8 unless otherwise specified. Disqualifying defects discovered between weld passes shall be repaired before additional weld material is deposited. Wherever a defect is removed, and repair by welding is not required, the affected area shall be blended into the surrounding surface eliminating sharp notches, crevices, or corners. After defect removal is complete and before rewelding, the area shall be examined by the same test method which first revealed the defect to ensure that the defect has been eliminated. After rewelding, the repaired area shall be reexamined by the same test method originally used for that area. Any indication of a defect shall be regarded as a defect unless reevaluation by NDE or by surface conditioning shows that no disqualifying defects are

present. The use of any foreign material to mask, fill in, seal, or disguise welding defects will not be permitted.

-- End of Section --

SECTION 06600

FIBERGLASS REINFORCED PLASTIC FABRICATIONS - GENERAL

PART 1 GENERAL

1.1 DESCRIPTION

1.1.1 Scope:

1.1.1.1 This Section provides quality standards for all fabricated fiberglass reinforced plastic products of this Division and any other Section containing FRP products. The FRP products shall include, but not be limited to the following:

- a. FRP Guardrails and Appurtenances.
- b. FRP Grating.
- c. FRP Structural Shapes.
- d. FRP Ladders.
- e. FRP Electrical Panels.

1.1.2 Related Divisions and Sections:

1.1.2.1 Division 1, General Requirements.

1.1.2.2 Section 03252, Concrete Anchors.

1.1.2.3 Section 06610, Fiberglass Reinforced Plastic Guardrail and Ladders.

1.1.2.4 Section 06611, Fiberglass Reinforced Plastic Grating and Structural Shapes.

1.1.2.5 Division 16, Electrical.

1.2 QUALITY CONTROL

1.2.1 Manufacturer's Qualifications: Qualifications of the Manufacturer shall be specified under the Specification Section.

1.2.2 Single Supplier: All FRP products and appurtenances specified under a given specification section shall be furnished by a single equipment manufacturer who shall assume full responsibility for the completeness of the system.

1.2.3 Source Quality Tests:

1.2.3.1 Shop Tests: Shop tests for the FRP items specified shall be as specified in that section.

1.2.3.2 Field Tests: Field tests for the FRP items specified shall be as specified in that section.

1.2.4 Reference Standards: Except as otherwise indicated, the current editions of the following apply to the FRP items specified:

NBS PS 15-69	Custom Contact-Molded Reinforced Polyester Chemical-Resistant Process Equipment.
ASTM A 325	Specification for High-Strength Bolts for Structural Steel Joints.
ASTM A 490	Specification for Heat-Treated Steel Structural Bolts 150 ksi (1035 MPa) Tensile Strength.
ASTM D 570	Test Method for Water Adsorption of Plastics.
ASTM C 581	Practice For Determining Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures, Intended for Liquid Service.
ASTM C 582	Contact Molded Reinforced Thermosetting Polyester Laminates for Corrosion Resistant Equipment.
ASTM D 256	Test Method for Determining the Pendulum Impact Resistance of Notched Specimens of Plastics.
ASTM D 638	Test Method for Tensile Properties of Polyesters.
ASTM D 695	Test Method for Compressive Properties of Rigid Polyesters.
ASTM D 696	Test Method for Coefficient of Linear Thermal Expansion of Plastics.
ASTM D 790	Test Methods for Flexural Properties of Unreinforced and Reinforced Polyesters and Electrical Insulating Materials.
ASTM D 883	Definitions of Terms Relating to Polyesters.
ASTM D 953	Standard Test Method for Bearing Strength of Plastics.
ASTM D 2563	Recommended Practice for Classifying Visual Defects in Glass-Reinforced Polyester Laminate Parts.
ASTM D 2583	Test Method for Indentation Hardness of Rigid Polyesters by Means of a Barcol Impressor.
ASTM D 2584	Test Method for Ignition Loss of Cured Reinforced Resins.
ASTM D 3846	Standard Test Method for In-Plane Shear Strength of Reinforced Plastics.
NFPA 255	Method of Test for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

1.3.1 See individual FRP product specifications.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

1.4.1 See individual FRP product specifications.

1.5 WARRANTY

1.5.1 See individual FRP product specifications.

PART 2 PRODUCTS

2.1 GENERAL

2.1.1 General: Only products certified as complying with the indicated requirements shall be provided.

2.1.2 Products: All items shall be new, of current design, from reputable manufacturers specializing in such products.

2.1.3 Manufacturer's Recommendations: Products shall be recommended by the manufacturer for the application indicated.

2.2 GENERAL REQUIREMENTS

2.2.1 Quality: All FRP items shall be manufactured by the pultrusion process using a vinylester resin system of the material properties, thickness, and dimensions as indicated on drawings and individual FRP product specifications.

2.2.2 Finish: Finished surfaces of FRP items and fabrications shall be smooth, resin-rich, free of voids, without dry spots and unreinforced areas, corrosion resistant and without exposed glass fibers.

2.2.3 Supports and Fasteners: Bolts, anchor bolts, washers, nuts and supports shall be fabricated of Type 316 stainless steel, unless otherwise indicated.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Products shall be installed in accordance with the manufacturer's installation instructions.

-- END OF SECTION --

SECTION 06610

FIBERGLASS REINFORCED PLASTIC (FRP) GUARDRAILS AND LADDERS

PART 1 GENERAL

1.1 DESCRIPTION

1.1.1 Scope:

1.1.1.1 The CONTRACTOR shall provide all labor, materials, equipment, services and incidentals as shown, specified and required to furnish and install fiberglass reinforced plastic (FRP) guardrail, ladders and appurtenances.

1.1.2 Related Divisions and Sections:

1.1.2.1 Division 1, General Requirements.

1.1.2.2 Section 03252, Concrete Anchors.

1.1.2.3 Section 06600, Fiberglass Reinforced Plastic Fabrications - General.

1.1.3 The extent and location of FRP guardrail and ladders is shown and specified on the drawings.

1.1.4 The type of (FRP) guardrail and ladders Work required includes, but is not limited to, the following:

1.1.4.1 Top and intermediate horizontal railing.

1.1.4.2 Handrail posts.

1.1.4.3 Toeboards.

1.1.4.4 Ladders.

1.1.4.5 Anchors and fasteners.

1.1.4.6 Sleeves, castings, reinforcing inserts, wall brackets, and other miscellaneous accessories.

1.2 QUALITY CONTROL

1.2.1 Manufacturer's Qualifications: Manufacturer shall have experience in manufacturing FRP guardrail and ladders equal to that specified. For a manufacturer to be determined acceptable for providing FRP guardrail and ladders on this project, it must show evidence of five separate, substantially similar installations which have been in satisfactory operation for a minimum of five years.

1.2.2 All equipment provided under this Section shall be obtained from a single supplier or manufacturer who, with the Contractor, shall assume full responsibility for the completeness of the system. The supplier or manufacturer shall be the source of information on all equipment furnished regardless of the manufacturing source of that equipment.

1.2.3 Source Quality Control:

1.2.3.1 Shop Tests.

1.2.3.2 Field Tests.

1.2.4 In addition to the codes, specifications and standards specified in Section 06600, comply with the following:

ASTM D 256	Test Method for Determining the Pendulum Impact Resistance of Notched Specimens of Plastics.
ASTM D 570	Test Method for Water Adsorption of Plastics.
ASTM D 696	Test Method for Coefficient of Linear Thermal Expansion of Plastics.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having and "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES.

SD-01 Data

Furnish certification by manufacturer that load tests have been performed on the FRP guardrail and ladder systems Work and that they conform to all applicable OSHA, ANSI and building code requirements for loading and deflections and meet minimum criteria specified herein. FIO

Calculations for the complete structural design of the FRP guardrail and ladder systems Work including calculations showing compliance with design criteria specified. Calculations must be signed and sealed by an Engineer licensed to practice in Washington, D.C. GA|WA

Furnish certification that manufacturer has been apprised of the nature of each area in which FRP guardrail or ladders are to be installed, and that these items being provided are resistant to the corrosion effects of any chemical present in the area. FIO

Manufacturer's Qualifications: In accordance with Part 1.2.1 of this Section. FIO

SD-04 Drawings

Shop drawings for the fabrication and erection of FRP guardrail and ladder systems Work. Include all plans and elevations identifying the location of all handrail and railing, and details of sections and connections. Show all anchorage items and details for attachment of the handrail to concrete and FRP surfaces. GA|WA

SD-14 Samples

Full size sample of assembled post and rails intersections with all associated components including mounted toeboard and socket, including typical connections, with rails not less than 6 inches long. Samples will be reviewed for finish, color, joinery tolerances, workmanship and general component assembly only. Compliance with all other requirements is the exclusive responsibility of CONTRACTOR. GA|WA

Samples of ladder components.

SD-19 Operation and Maintenance Manuals

Upon completion of the Work, furnish copies of detailed owner's manual in accordance with Section 01300 including the following information: FIO

- a. Product name and number.
- b. Name, address and telephone number of manufacturer and local distributor.
- c. Detailed procedures for routine maintenance and cleaning, including cleaning materials, application methods and precautions as to use of materials that may be detrimental to finish when improperly applied.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

1.4.1 Deliver materials including anchorage devices to the site to insure uninterrupted progress of the Work.

1.4.2 Handle all FRP guardrail, ladders and appurtenances very carefully. Handrail which is damaged will not be acceptable. Protect all bolt threads, etc. from damage and corrosion.

1.4.3 Store materials to permit easy access for inspection and identification. Protect equipment including packaged materials from damage.

1.5 WARRANTY

1.5.1 The Contractor shall obtain from the manufacturer a warranty for all FRP guardrail, ladders and appurtenances for one year from the date of Substantial Completion.

1.5.2 During the warranty period, the Contractor shall provide the services of a trained manufacturer's representative to make all adjustments, repairs, and replace all defective equipment at no cost to the Contracting Officer.

1.5.3 The Contractor shall include all costs incurred by the manufacturer, including travel and expenses, under the terms of the warranty.

PART 2 PRODUCTS

2.1 DESIGN CRITERIA

2.1.1 Provide adequate expansion within the fabricated guardrail system which allows a thermal change of 100°F above installation temperature without warp or bow. Provide 0.1 inch space for each 20 feet of length of rail for each 25°F difference of thermal change specified or use manufacturer's published formulas for determining expansion joint movement and spacing. Limit the exposed width of each expansion joint to 1/4 inch.

2.1.2 Provide expansion joint in guardrail system Work where systems cross expansion joints in structure and where runs of railing require joints.

2.1.3 Configuration of all guardrail and ladder details shall conform to requirements of all applicable Building Codes.

2.1.4 Select systems components and post spacing so that specified applied loads produce no permanent set in the completed guardrail system Work.

2.1.5 Provide FRP guardrail system Work that conforms to OSHA, Part 1910.23, including the 200-pound loading requirement. In addition, the system shall

conform to the following requirements of ANSI A1264.1:

2.1.5.1 Completed guardrail system Work to withstand a load of 25 pounds per linear foot applied in any direction at the top of the guardrail.

2.1.5.2 Intermediate rail to withstand a horizontal load of 25 pounds per linear foot.

2.1.5.3 All above loads are not additive.

2.1.6 FRP ladders shall meet the requirements set forth in OSHA 1910.27. Ladders shall also be capable of supporting a concentrated vertical load of 1200 pounds applied at the midspan of the rung.

2.1.7 All of the FRP provided under this Section shall be safety yellow in color. No separately cured gel coat shall be allowed.

2.2 ALLOWABLE TOLERANCES

2.2.1 Limit variation of cast-in-place inserts, sleeves and field- drilled holes to the following:

2.2.1.1 Spacing: $\pm 3/8$ inch.

2.2.1.2 Alignment: $\pm 1/4$ inch.

2.2.1.3 Plumbness: $\pm 1/8$ inch.

2.2.2 Limit variation of completed guardrail system alignment to $1/4$ inch in 12 feet.

2.3 MATERIALS

2.3.1 Fiberglass reinforced plastic (FRP) guardrail components and ladders shall be manufactured by the pultrusion process and assembled according to the American Society of Testing and Materials Specification (ASTM) F1092-87, entitled "Standard Specification for Fiberglass Pultruded Open-Weather Storm and Guard Square Handrails."

2.3.2 Resin used throughout the component parts of guardrail system and ladders shall be vinyl ester with flame retardant additives to meet flame rating of 25 or less in accordance with ASTM E-84 testing.

2.3.3 Reinforcing shall be Type C glass, and shall be placed in a ratio of 25 percent glass to 75 percent resin.

2.3.4 Railing posts shall be made of 2 inches square tube by $1/4$ -inch wall thickness and shall be assembled with 316 stainless steel fasteners.

2.3.5 Ladder rail size shall be as required by the Design Criteria stated herein and as shown on drawings, but shall be 2 inches square by $1/4$ -inch wall thickness minimum.

2.3.6 Ladder rungs shall be 1-inch diameter (minimum) solid thermal cure rods with a pigmented epoxy, non-skid grit surface.

2.3.7 Anchors and Fastenings: 316 stainless steel of the type recommended by the manufacturer of the FRP guardrail system and ladders. Provide minimum of four bolt fasteners per post.

2.3.8 Chain, Snaps and Eye Bolts: Provide oblong 0.250-inch welded link, Type 316 stainless steel chain weighing 57 pounds per cubic foot, each link 1-1/8-inch by 7/16-inch as shown on drawings. Provide stainless steel eyebolts, 1/4-inch stainless steel threaded quick links and heavy duty swivel snaps with spring loaded latch.

2.3.9 Components and Miscellaneous Accessories: Provide a complete selection of manufacturer's standard and custom FRP guardrail system components and miscellaneous accessories.

2.4 FABRICATION

2.4.1 Guardrail System

2.4.1.1 Form exposed Work true to line and level with accurate angles, surfaces and straight edges.

2.4.1.2 Form corners to the radius shown without causing grain separation or otherwise impairing the Work. Form all change in railing direction with radius bends.

2.4.1.3 Form elbow bends and wall returns to uniform radius, free from buckles and twists, with smooth finished surfaces, or use prefabricated bends.

2.4.1.4 Locate intermediate rails equally spaced between top rail and finished floor.

2.4.1.5 Toeboards:

- a. Unless otherwise specified, toeboards shall meet requirements of OSHA Part 1910.23, Section (e) and all applicable Building Codes.
- b. Provide manufacturer's toeboard detail which accommodates movement caused by thermal change specified without warping or bowing toeboards.

2.4.2 Ladders:

2.4.2.1 All ladders shall be shop assembled, predrilled and prepared for field installation.

PART 3 EXECUTION

3.1 FIELD MEASUREMENTS AND SHOP ASSEMBLY

3.1.1 Field Measurements: Take field measurements, where required, prior to preparation of Shop Drawings and fabrication to ensure proper fitting of the Work.

3.1.2 Shop Assembly: Preassemble items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the project site. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinate installation.

3.2 INSPECTION

3.2.1 Contractor shall examine the substrate and conditions under which the FRP guardrail and ladder system Work is to be performed and notify Contracting Officer in writing of unsatisfactory tolerances which exceed specified limits

and other conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions have been corrected by the Contractor.

3.3 INSTALLATION

3.3.1 Fastening to In-Place Construction:

3.3.1.1 Adjust FRP handrail and railing system prior to securing in place, to ensure proper matching at butting joints and correct alignment throughout their length. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

- a. Anchor railing in concrete by means of sockets and side mounted fascia flange brackets, using 316 stainless steel fasteners, set and anchored into the sides of concrete walls. Provide closure secured to the bottom of sleeve.
- b. Fasten posts to FRP structural framing using a side-mount connection detail with 316 stainless steel bolts as recommended by manufacturer.

3.3.1.2 Fasteners used to attach ladders shall be 316 stainless steel size and quantity as recommended by manufacturer.

3.3.2 Cutting, Fitting and Placement:

3.3.2.1 Perform cutting, drilling and fitting required for installation. Set the Work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels.

3.3.2.2 All cut or machined edges, holes and abrasions shall be sealed with the same resin used in the resin/glass matrix of the structural shape. All seals shall match the color of the original component.

3.3.2.3 Fit exposed connections accurately together to form tight hairline joints. Do not cut or abrade the surfaces of units which have been finished after fabrication, and are intended for field connections.

3.3.2.4 Permanent field splice connections shall be made using manufacturer's recommended epoxy adhesive and 5-inch minimum length connector sleeves. Tight press-fit all field splice connectors and install in accordance with manufacturer's written instructions. Follow epoxy manufacturer's recommendations for requirements of installation and conditions of use.

3.3.2.5 Make all splices as near as possible to posts but not exceeding 12 inches from nearest post.

3.3.2.6 Space posts 6 foot-0 inch minimum on centers and 8 foot-0 inch maximum on centers, based on loading and deflection criteria specified and manufacturer's suggested maximum spacing except where details show dimensions which dictate required locations for posts. Where details show post location requirements at or near end of runs, uniformly space intermediate posts as required to meet loading and deflection criteria specified but not greater than maximum spacing specified.

3.3.2.7 Contractor shall adjust guardrail and post installation at all locations where interference is encountered. Clearance between railing and operating equipment and piping shall not be less than 6 inches.

3.3.2.8 Provide chain sections as shown and specified. Provide one chain length with fastening accessories for top and each intermediate railing.

3.3.2.9 Secure railing to walls with wall brackets and end fittings as specified. Locate brackets at not more than 5 feet on centers.

3.3.2.10 Secure wall brackets to existing concrete using anchor bolts as specified.

3.3.2.11 Securely fasten toeboards in place with not more than 1/4-inch clearance above floor level.

3.3.3 Expansion Joints:

3.3.3.1 Provide slip joint with internal sleeve extending 2 inches minimum beyond joint on each side.

3.3.3.2 Construct expansion joints as for field splices except fasten internal sleeve securely to one side of rail only.

3.3.3.3 Locate joints within 6 inches of posts.

3.3.3.4 Submit locations and details of all expansion joints to the Contracting Officer.

3.4 CLEANING AND REPAIRING

3.4.1 Remove protective plastic as recommended by manufacturer immediately after installation.

3.4.2 Remove all stains, dirt, grease or other substances by washing railings thoroughly using clean water and soap; rinse with clean water.

3.4.3 Do not use acid solution, steel wool or other harsh abrasives. If stain remains after washing remove defective sections and replace with new material meeting the requirements of the Contract Documents.

3.4.4 Remove all damaged or otherwise defective Work and replace with material that meets specification requirements.

-- END OF SECTION --

SECTION 06611

FIBERGLASS REINFORCED PLASTIC (FRP) GRATING AND STRUCTURAL SHAPES

PART 1 GENERAL

1.1 DESCRIPTION

1.1.1 Scope:

1.1.1.1 CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install FRP and appurtenances complete and operational as shown and specified.

1.1.2 Related Divisions and Sections:

1.1.2.1 Division 1, General Requirements.

1.1.2.2 Section 03252, Concrete Anchors.

1.1.2.3 Section 06600, Fiberglass Reinforced Plastic Fabrications - General.

1.1.2.4 Section 06610, Fiberglass Reinforced Plastic Guardrails and Ladders.

1.2 QUALITY CONTROL

1.2.1 Manufacturer's Qualifications: Manufacturer shall have experience in manufacturing the FRP grating and structural shapes as shown on drawings and specified. For a manufacturer to be determined acceptable for providing FRP grating and structural shapes on this project, it must show evidence of five separate, substantially similar installations which have been in satisfactory operation for a minimum of 5 years.

1.2.2 All materials provided under this Section shall be obtained from a single supplier or manufacturer who, with the CONTRACTOR, shall assume full responsibility for the completeness of the system. The supplier or manufacturer shall be the source of information on all materials furnished regardless of the manufacturing source of the materials.

1.2.3 Source Quality Control:

1.2.3.1 Shop Tests: See 1.3, Submittals.

1.2.3.2 Field Tests.

1.2.4 Reference Standards: The standards listed in Section 06600, shall apply to the work. In particular, the following standards shall apply:

ASTM D 256	Test Method for Determining the Pendulum Impact Resistance of Notched Specimens of Plastics.
ASTM D 638	Test Method for Tensile Properties of Polyesters.
ASTM D 695	Test Method for Compressive Properties of Rigid Polyesters.

ASTM D 790	Test Methods for Flexural Properties of Unreinforced and Reinforced Polyesters and Electrical Insulating Materials.
ASTM D 953	Standard Test Method for Bearing Strength of Plastics.
ASTM D 3846	Standard Test Method for In-Plane Shear Strength of Reinforced Plastics.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having and "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES.

SD-01 Data

Product Data: Submit manufacturer's published literature for specific products and accessories as applicable, including manufacturer's specifications, physical characteristics, performance data, load tables and installation recommendations. GA|WA

Experience: Proof that the grating manufacturer has produced this grating product for at least 5 years and has successfully used product for similar applications in this industry. GA|WA

Field Support: Name, address, and telephone number of manufacturer or manufacturer's representative who will provide field support. FIO

Submit manufacturer's standard color chart for grating and structural shapes. GA|WA

Submit data for shop tests on all grating and structural shapes used in the Work. FIO

SD-04 Drawings

Shop Drawings: Shop drawings for the layout, fabrication, and installation of the grating and all structural members of the platform. All cut-out locations, if any, in the grating shall be located on shop drawings. GA|WA

The grating and structural members shall not be fabricated until the manufacturer's shop drawings, based on Contractor's field measurements, are approved by the Contracting Officer.

SD-14 Samples

Product Sample: The approved submittal sample shall become the standard for acceptable workmanship for the order. GA|WA

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

1.4.1 Deliver materials to the site to insure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices in ample time not to delay the Work.

1.4.2 Handle all FRP grating, structural shapes and appurtenances very carefully. Products which are damaged will not be acceptable. Protect all bolt threads, etc. from damage and corrosion.

1.4.3 Store materials to permit easy access for inspection and identification. Protect all products including packaged materials from damage and deterioration while being stored.

1.5 WARRANTY

1.5.1 The Contractor shall obtain from the manufacturer a warranty for all FRP grating, structural shapes and appurtenances for one year from the date of Substantial Completion.

1.5.2 During the warranty period, the Contractor shall provide the services of a trained manufacturer's representative to make all adjustments, repairs and replace all defective material at no cost to the Contracting Officer.

1.5.3 The Contractor shall include all costs incurred by the manufacturer, including travel and expenses, under the terms of the warranty.

PART 2 PRODUCTS

2.1 FRP GRATING AND STRUCTURAL SHAPES

2.1.1 Design Criteria

2.1.1.1 FRP grating supplied shall be designed to resist the loads shown on the drawings and shall include all necessary connections. Maximum permissible deflection 1/4 of an inch.

2.1.1.2 FRP structural shapes shall be provided with the minimum design properties as shown on the drawings.

2.1.1.3 Provide connections between FRP structural shapes sufficient to carry the maximum load carrying capacity of the shape. Provide connections to existing concrete as shown on drawings.

2.1.2 Materials and Fabrication

2.1.2.1 FRP Grating:

- a. Fiberglass grating shall be made from a premium grade chemical resistant, fire retardant vinyl ester resin system which meets the flame rating of 25 or less in accordance with ASTM E-84 testing and meets the self-extinguishing requirements of ASTM D-635. U.V. inhibitor shall be added to the resin.
- b. The FRP grating shall be fabricated from bearing bars and cross rods manufactured by the pultrusion process. The bearing bars shall be "I" or "T" shaped and shall be spaced 1½ inches or less center to center. The glass fiber reinforcement for the bearing bars shall be a core of continuous glass strand rovings wrapped with continuous strand glass mat. A synthetic surface veil shall be the outermost layer covering the exterior surfaces.

The bearing bars shall be joined into panels by passing continuous length fiberglass pultruded cross rods through the web of each bearing bar at a spacing of 6 inches or less center to center. The pultruded cross rod assembly shall consist of two cross rod spacers that have notches cut into them to fit the distance between the web of each bearing bar. A continuous fiberglass pultruded bar shaped section shall be wedged between the two cross rod spacers mechanically locking the notches in the cross rod

spacers to the web of the bearing bars. Continuous chemical bonding shall be achieved between the cross rod spacers and the bearing web and between the bar shaped wedge and the two cross rod spacers locking the entire panel together to give a panel that resists twists and prevents internal movement of the bearing bars.

- c. All FRP grating shall be U.V. resistant.
- d. All FRP grating shall be covered with a permanently bonded grit, baked epoxy, anti-skid surface.

2.1.2.2 FRP Structural Shapes.

- a. Structural shapes shall be made from a premium grade vinyl ester resin with fire retardant additives to meet Class 1 flame rating of ASTM E-84 and meet the self-extinguishing requirements of ASTM D-635. All structural shapes shall contain a U.V. inhibitor.
- b. Manufactured by the pultrusion process.
- c. Structural FRP members composition shall consist of a glass fiber reinforced vinyl ester resin matrix, approximately 50% resin to glass ratio. A synthetic surface veil shall be the outermost layer covering the exterior surfaces. Glass strand rovings shall be used internally for longitudinal strength. Continuous strand glass mats shall be used internally for transverse strength.

2.2 ACCEPTABLE MANUFACTURER

2.2.1 The CONTRACTOR shall furnish and install FRP grating, structural shapes and accessories by one of the following manufacturers, or equal:

- 2.2.1.1 Strongwell.
- 2.2.1.2 Fibergrate.
- 2.2.1.3 Creative Pultrusions, Inc.
- 2.2.1.4 Or equal.

PART 3 EXECUTION

3.1 FIELD VERIFICATION

3.1.1 The Contractor shall take detailed field measurements of all existing conditions in the vicinity of the proposed platforms and prepare a detailed drawing for use by a manufacturer in preparing the submittal drawings.

3.2 INSPECTION

3.1.2 Inspection of the grating is authorized and can be made at the manufacturer's plant and/or the fabricator and/or the job site. Grating shall be as free, as commercially possible, from visual defects such as foreign inclusions, delamination, blisters, resin burns, air bubbles and pits. The surface shall have a smooth finish (except for grit top surfaces) with an average of not over 4 surface pits per square foot of surface area, with no pits exceeding 1/8 inch diameter, or a 1/32 inch depth.

3.3 PRODUCT HANDLING AND STORAGE

3.3.1 Store grating on pallets and cover. Do not top load. Separate each piece with a non-scratching spacer, such as wood.

3.3.2 Protect from damage. Avoid sharp or impinging loads such as chain slings. Do not drag panels across one another unless separated by a non-scratching spacer.

3.3.3 Sand and re-surface coat any scratches, crushed or chipped edges as required in the field according to manufacturers repair methods.

3.4 INSTALLATION

3.4.1 Perform all installation in accordance with the drawings and the approved submittals.

3.4.2 Check supporting structurals for correct layout and alignment. Verify that support surfaces are free of debris. Check measurement of grating to determine fit.

3.4.3 Set the Work accurately in location, alignment and elevation; plumb, level, true and free from rack; measured from established lines and levels.

3.4.4 Fit grating panels together to form 1/4 inch joints at adjoining panels and at exterior curbs, unless otherwise indicated. Align bars of adjoining panels of grating.

3.4.5 Tolerances of cuts and of fitting panels shall be +/- 1/8 inch.

3.4.6 Field cutting of grating or shapes not allowed. Shop-cut or sanded surfaces shall be coated with resin furnished by manufacturer and applied in accordance with manufacturer's instructions. All cut edges and openings shall be banded.

3.4.7 Provide support angles of material similar to structural shapes. Angles shall meet specified requirements for structural shapes. Miter all edge support angles at intersections.

3.4.8 Hold-down clips shall be type 316L stainless steel spaced a maximum of 4 feet apart with a minimum of four per piece of grating, unless otherwise noted. Clips shall be provided by grating manufacturer.

3.4.9 Provide removable panels of grating as indicated on drawings.

3.4.10 If the Scope of Work requires the contractor to perform additional tasks which may damage the installed grating, the contractor is responsible for covering the grating with plywood, or other suitable protective material.

-- End Of Section --

SECTION 07900

JOINT SEALING

06/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 509	(1994) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM D 1056	(1998) Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1565	(1999) Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Open-Cell Foam)
ASTM E 84	(1999) Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Backing; G|WA.

Bond-Breaker; G|WA.

Sealant; G|WA.

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). A copy of the Material Safety Data Sheet shall be provided for each solvent, primer or sealant material.

SD-07 Certificates

Sealant; G|WA.

Certificates of compliance stating that the materials conform to the specified requirements.

1.3 ENVIRONMENTAL REQUIREMENTS

The ambient temperature shall be within the limits of 40 to 90 degrees F when the sealants are applied.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the job in the manufacturer's original unopened containers. The container label or accompanying data sheet shall include the following information as applicable: manufacturer, name of material, formula or specification number, lot number, color, date of manufacture, mixing instructions, shelf life, and curing time at the standard conditions for laboratory tests. Materials shall be handled and stored to prevent inclusion of foreign materials. Materials shall be stored at temperatures between 40 and 90 degrees F unless otherwise specified by the manufacturer.

PART 2 PRODUCTS

2.1 BACKING

Backing shall be 25 to 33 percent oversize for closed cell and 40 to 50 percent oversize for open cell material, unless otherwise indicated.

2.2 BOND-BREAKER

Bond-breaker shall be as recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

2.3 PRIMER

Primer shall be non-staining type as recommended by sealant manufacturer for the application.

2.4 SEALANT

2.4.1 ELASTOMERIC

Elastomeric sealants shall conform to ASTM C 920 and the following:

- a. Polyurethane sealant: Grade NS, Class 25, Use M.

2.4.2 PREFORMED

Preformed sealant shall be polybutylene or isoprene-butylene based pressure sensitive weather resistant foam strip capable of sealing out moisture, air and dust when installed as recommended by the manufacturer. At temperatures from minus 30 to plus 160 degrees F, the sealant shall be non-bleeding and shall have no loss of adhesion.

2.4.2.1 Foam Strip

Foam strip shall be polyurethane foam. Foam strip shall be capable of sealing out moisture, air, and dust when installed and compressed as recommended by the manufacturer. Service temperature shall be minus 40 to plus 275 degrees F. Untreated strips shall be furnished with adhesive to

hold them in place. Adhesive shall not stain or bleed into adjacent finishes. Treated strips shall be saturated with butylene waterproofing or impregnated with asphalt.

2.5 SOLVENTS AND CLEANING AGENTS

Solvents, cleaning agents, and accessory materials shall be provided as recommended by the manufacturer.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Surface Preparation

The surfaces of joints to receive sealant or caulk shall be free of all frost, condensation and moisture. Oil, grease, dirt, chalk, particles of mortar, dust, loose rust, loose mill scale, and other foreign substances shall be removed from surfaces of joints to be in contact with the sealant.

Oil and grease shall be removed with solvent and surfaces shall be wiped dry with clean cloths. For surface types not listed below, the sealant manufacturer shall be contacted for specific recommendations.

3.1.2 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, the materials shall be removed by sandblasting or wire brushing. Laitance, efflorescence and loose mortar shall be removed from the joint cavity.

3.1.3 Steel Surfaces

Steel surfaces to be in contact with sealant shall be sandblasted or, if sandblasting would not be practical or would damage adjacent finish work, the metal shall be scraped and wire brushed to remove loose mill scale. Protective coatings on steel surfaces shall be removed by sandblasting or by a solvent that leaves no residue.

3.2 APPLICATION

3.2.1 Masking Tape

Masking tape shall be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Masking tape shall be removed within 10 minutes after joint has been filled and tooled.

3.2.2 Backing

Backing shall be installed to provide the indicated sealant depth. The installation tool shall be shaped to avoid puncturing the backing.

3.2.3 Bond-Breaker

Bond-breaker shall be applied to fully cover the bottom of the joint without contaminating the sides where sealant adhesion is required.

3.2.4 Primer

Primer shall be used on concrete masonry units, or other porous surfaces in accordance with instructions furnished with the sealant. Primer shall be applied to the joint surfaces to be sealed. Surfaces adjacent to joints shall not be primed.

3.2.5 Sealant

Sealant shall be used before expiration of shelf life. Multi-component sealants shall be mixed according to manufacturer's printed instructions. Sealant in guns shall be applied with a nozzle of proper size to fit the width of joint. Joints shall be sealed as detailed in the drawings. Sealant shall be forced into joints with sufficient pressure to expel air and fill the groove solidly. Sealant shall be installed to the indicated depth without displacing the backing. Unless otherwise indicated, specified, or recommended by the manufacturer, the installed sealant shall be dry tooled to produce a uniformly smooth surface free of wrinkles and to ensure full adhesion to the sides of the joint; the use of solvents, soapy water, etc., will not be allowed. Sealants shall be installed free of air pockets, foreign embedded matter, ridges and sags. Sealer shall be applied over the sealant when and as specified by the sealant manufacturer.

3.3 CLEANING

The surfaces adjoining the sealed joints shall be cleaned of smears and other soiling resulting from the sealant application as work progresses.

-- End of Section --

SECTION 08110

STEEL DOORS AND FRAMES
09/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A250.4 (1994) Test Procedure and Acceptance
Criteria for Physical Endurance for Steel
Doors and Hardware Reinforcings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 591/A 591M (1998) Steel Sheet, Electrolytic
Zinc-Coated, for Light Coating Mass
Applications

ASTM A 653/A 653M (1998) Steel Sheet, Zinc-Coated
(Galvanized) or Zinc-Iron Alloy-Coated
(Galvannealed) by the Hot-Dip Process

ASTM C 578 (1995) Rigid, Cellular Polystyrene Thermal
Insulation

ASTM C 591 (1994) Unfaced Preformed Rigid Cellular
Polyisocyanurate Thermal Insulation

ASTM C 665 (1998) Mineral-Fiber Blanket Thermal
Insulation for Light Frame Construction
and Manufactured Housing

ASTM D 2863 (1997) Measuring the Minimum Oxygen
Concentration to Support Candle-Like
Combustion of Plastics (Oxygen Index)

ASTM E 283 (1991) Rate of Air Leakage Through
Exterior Windows, Curtain Walls, and Doors
Under Specified Pressure Differences
Across the Specimen

ASTM A 167 Stainless Steel and Heat-Resisting
Chromium-Nickel Steel Plate, Sheet, and
Strip

ASTM A 176 Stainless and Heat-Resisting Chromium
Steel Plate, Sheet, and Strip

DOOR AND HARDWARE INSTITUTE (DHI)

ANSI/DHI A115 (1991) Steel Door Preparation Standards

(Consisting of A115.1 through A115.6 and
A115.12 through A115.18)

HOLLOW METAL MANUFACTURER'S ASSOCIATION (HMMA)

HMMA HMM (1992) Hollow Metal Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (1995) Fire Doors and Fire Windows

NFPA 105 (1993) Smoke-Control Door Assemblies

NFPA 252 (1995) Fire Tests of Door Assemblies

STEEL DOOR INSTITUTE (SDI)

ANSI/SDI 100 (1991) Standard Steel Doors and Frames

SDI 105 (1992) Recommended Erection Instructions
for Steel Frames

SDI 107 (1984) Hardware on Steel Doors
(Reinforcement - Application)

SDI 111B Recommended Standard Details for Dutch
Doors

SDI 111F Recommended Completed Opening Anchors for
Standard Steel Doors and Frames

SDI 113 (1979) Apparent Thermal Performance for
Steel Door and Frame Assemblies

SDI 114 (1979) Acoustical Performance for Steel
Door and Frame Assemblies

UNDERWRITERS LABORATORIES INC. (UL)

UL 10B (1997) Fire Tests of Door Assemblies

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal
Procedures."

SD-02 Shop Drawings

Doors; G|WA

Frames; G|WA

Accessories; G|WA

Weatherstripping; G|WA

Show elevations, construction details, metal gages, hardware
provisions, method of glazing, and installation details.

SD-03 Product Data

Doors; G|WA

Frames; G|WA

Accessories; G|WA

Weatherstripping; G|WA

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction.

SD-04 Samples

Door and Frame Samples; G|WA

Stainless steel used in each product from manufacturer of item. Include complete range samples of all finishes specified for final selection by Engineer.

Provide cut away 12-inch by 12-inch corner section sample of doors and frames of "or equal" manufacturers with all construction and features of fabrication identified and compared to product specified.

Engineer reserves the right to require samples showing fabrication techniques and workmanship of component parts, and the design of accessories and other exposed auxiliary items for all door and from Work, before fabrication of the Work proceeds.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4 inch airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 STAINLESS STEEL DOORS AND FRAMES

Door Faces, Frames and All Internal Sub-Core Sheet and Stiffeners: AISI Type 316 stainless steel complying with ASTM A 167. Provide uniform fine glass bead-blasted finish on all external material or stainless steel doors and frames. Supports and Anchors: Sheet metal, Type 316 stainless steel, complying with ASTM A 176, Class B. Inserts, Bolts and Fasteners: Type 316 stainless steel complying with ASTM A 453.

2.2 FABRICATION

Fabricate units to be rigid, neat in appearance and free of defects, warp or buckle. Accurately form metal to required sizes and profiles. Wherever

practicable, fit and assemble units in the manufacturer's plant. Clearly identify Work, that cannot be permanently factory-assembled before shipment, to assure proper assembly at the project site. Weld exposed joints continuously, grind, dress, and make smooth, flush and invisible. Filler to conceal manufacturing defects is not acceptable.

Exposed Fasteners: Unless otherwise specified, provide countersunk flat Phillips or Jackson heads for exposed screws and bolts.

Finish Hardware Preparation:

- a. Prepare units to receive mortised and concealed finish hardware, including cutouts, reinforcing, drilling and tapping in accordance with final Finish Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A115, Specifications for Door and Frame Preparation for Hardware.
- b. Reinforce units to receive surface-applied and recessed finish hardware. Drilled and tapping for surface-applied finish hardware may be done at project site.
- c. Locate finish hardware as shown on approved Shop Drawings, in accordance with hardware templates provided by hardware manufacturer and in accordance with National Association of Architectural Metal Manufacturers, Hardware Locations for Hollow Metal Doors.
- d. Specified manufacturer's supplemental and special reinforcements for hinges, surface-applied closers, holders, coordinators, stops and strikes shall be manufacturer's standard but not less than specified and recommended for maximum heavy duty construction.

2.3 FLUSH DOORS

Door Types:

- a. Provide flush design doors, 1-3/4 inches thick, seamless hollow construction, unless otherwise shown or specified.
- b. Doors shall be provided with custom vision panels as shown.

2.4 DOOR CONSTRUCTION

Fabricate doors of two outer stretcher-leveled stainless steel sheets not less than 18 gauge Type 316 stainless steel with uniform fine glass bead-blast finish both sides of door. Construct doors with smooth, flush surfaces without visible joints, seams or weld marks on exposed faces or stile edges.

Provide seam on door edge continuously TIG welded full height of door. Provide weep hole openings in the bottom of exterior doors to permit the escape of entrapped moisture.

Reinforce inside of doors with 18 gauge stainless steel stiffeners spaced 6-inches apart and continuously welded to 16 gauge stainless steel sub-core skin 4-inches on center. Sound deadening, heat retarding, 17 pound density mineral coreboard with 100 psi minimum compressive strength at 10 percent deformation shall be solidly packed between the stiffener plates and shall extend for the entire height and width of the door. All metal used in the

construction of the door shall be stainless steel.

Reinforce tops and bottoms of doors will flush mounted minimum 16 gauge horizontal stainless steel closing channels welded continuously to the outer sheets. Close top and bottom edges of all doors both interior and exterior to provide weather seal, as integral part of door construction or by addition of inverted stainless steel channels installed flush with minimum of two flathead screws. Provide 16 gauge stainless steel closing plate spot welded to outer sheets. Provide flush closure channels continuously adhered to channel with structural silicone adhesive.

Edge profiles shall be provided on both stiles of doors as follows: Reveal 1/8 inch in 2 inches.

2.5 FINISH HARDWARE REINFORCEMENT

Hardware supplier shall furnish stainless steel door and frame manufacturer's approved hardware schedule, hardware templates, and samples of physical hardware where necessary to insure correct fitting and installation.

Preparation includes sinkages and cut-outs for mortised and concealed hardware.

Provide reinforcements for both concealed and surface-applied hardware.

- a. Drill and tap mortise reinforcements at factory, using templates.
- b. Install reinforcements with concealed connections designed to develop full strength of reinforcements.

Reinforce doors for required finish hardware. All reinforcement for machine screws shall be not less than 3/16-inch thick stainless steel plate. Provide minimum gauges as follows:

- a. Pivot Hinges: Stainless steel plate 3/16-inch thick full width of door by 8 inches longer than hinge and secured by not less than 6 spot or projection welds with top hinge further reinforced with a high-frequency back-up reinforcement.
- b. Mortise Locksets and Dead Bolts: 12 gauge stainless steel plate, secured with not less than 4 spot or projection welds and as required by ANSI A156.2.
- c. Flush Bolts: 12 gauge stainless steel plate, secured with not less than 2 spot or projection welds.
- d. Push Plates and Bars: 16 gage stainless steel sheet secured with not less than 2 spot or projection welds.
- e. Automatic Door Bottoms: Reinforce with 16 gauge stainless steel for surface-applied units.

2.6 FRAMES FOR FLUSH DOORS

Frame Types:

- a. Provide stainless steel frames for doors, as shown or specified.

- b. Provide arc-welded and ground smooth corners finished to match adjacent surfaces and with bottom spreader bar.

2.7 FRAME CONSTRUCTION

Fabricate frames of full-welded unit construction. Provide reinforced mitered corners that are continuously welded for the full depth and width of the frame. Grind all exposed welds flush and smooth. Form frames from Type 316 stainless steel.

Gage Thickness of Stainless Steel: Not less than 12.

Reinforce frames for required finish hardware.

- a. Pivot Hinges: Special, full width of frame stainless steel plate, 3/16-inch thick by 8-inches longer than hinge, secured for both rabbets by not less than 12 spot or projection welds.
- b. Strike Plate Clips: Stainless steel plate 10 gauge thick by 1-1/2-inches wide by 3 inches long.

Jamb Anchors: Furnish jamb anchors as required to secure frames to adjacent construction, formed of not less than 16 gage stainless steel.

- a. Cast In Place Concrete: Anchor frame jambs with minimum 3/8-inch concealed stainless steel bolts into expansion shields or inserts at 6 inches from top and bottom and 24 inches on center. Reinforce frames at anchor locations. Apply removable stop to cover anchor bolts.

Floor Anchors: Provide floor anchors for each jamb and mullion which extends to floor, formed of not less than 14 gage sheet to match metal of frame, as follows:

- a. Monolithic Concrete Slabs: Clip type anchors, with 2 holes to receive fasteners, welded to bottom of jambs and mullions.
- b. Separate Topping Concrete Slabs: Adjustable type with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of finish topping floor surface.

Where installed in masonry leave vertical mullions in frames open at the top so they can be filled with grout.

Spreader Bars: Provide removable spreader bar across bottom of frames.

Rubber Door Silencers: Drill stop to receive three silencers on single-door frames and four silencers on double-door frames. Install plastic plugs to keep holes clear during construction.

Mortar and Plaster Guards: Provide minimum 26 gage plaster guards or dust cover boxes to match metal of frame, welded to frame, at back of finish hardware cutouts.

2.8 STOPS AND MOULDINGS

Provide stops and mouldings around solid and glazed panels in stainless steel door units and in frames to receive glass, where shown.

Form fixed stops and mouldings integral with door face sheet. Provide fixed stops on exterior of stainless steel door units exposed to exterior and on corridor side of interior units.

Provide removable stops and moulds at other locations, machined from solid stainless steel bars with countersunk stainless steel machine screws with spanner heads spaced uniformly not more than 12 inches on center and with internal 3/16-inch continuous plate reinforcing around opening. Form corners with mitered hairline joints. Provide all surfaces with uniform fine glass bead-blasted finish.

PART 3 EXECUTION

3.1 INSTALLATION

Install units and accessories in accordance with approved Shop Drawings, manufacturer's data, and as shown and specified.

Frames that are bowed, twisted or otherwise unacceptable shall be removed from the jobsite and replaced with properly constructed frames.

Placing Frames:

- a. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. Remove spreader bars only after frames have been properly set and secured.
- b. Make field splices in frames as detailed on approved Shop Drawings, welded and finished to match factory Work.
- c. Doors frames shall be set by door vendor.
- d. Anchor components parts securely in place as shown, by bolting, or other permanent mechanical attachment system, which will comply with performance requirements and permit movements which are intended or necessary. Install slip-joint linings to ensure movement as intended or necessary.

Door Installation: Fit units accurately in their respective frames, with the following clearances:

- a. Jambs and Head: 3/32 inch.
- b. Meeting Edges, Pairs of Doors: 1/8 inch.
- c. Bottom; 3/4 inch, where no threshold or carpet.
- d. Bottom: At threshold, 1/8 inch.

All materials shall be installed by factory-trained erectors in strict accordance with installation data provided by approved Working Drawing submittal and these Specifications.

Install thresholds using stainless steel woodscrews with rawl plug type fastening 15 inches on centers set in a generous bead of specified sealant carefully located so as to engage the leading outside edge of the threshold without migrating onto concrete sidewalk. Immediately and before sealant cures clean from concrete and threshold any sealant which migrates from joint.

Do not install component parts which are observed to be defective in any way, including warped, bowed, dented, abraided and broken members, and including glass with edge damage.

Do not cut, or trim, component parts during erection, in a manner which would damage the finish, decrease the strength or result in a visual imperfection or a failure in performance. Return component parts which require alteration to a shop for refabrication, if possible, or for replacement with new parts.

Install component parts level, plumb, true to line and with uniform joints and reveals. Secure to structure with non-staining and non-corrosive shims, anchors, fasteners, spacers and fillers. Use erection equipment which will not mar or stain finished surfaces, and will not damage the component parts.

3.1.1 Doors

Hang doors in accordance with clearances specified in ANSI/SDI 100. After erection and glazing, clean and adjust hardware.

3.2 ADJUSTMENT AND CLEANING

Maintain the stainless steel doors and frames Work in a clean condition throughout the construction period, so that they will be without any evidence of deterioration or damage at the time of Final Acceptance. Select methods of cleaning which will promote the achievement of uniform appearance and stabilized colors and textures for materials that weather or age with exposure.

Remove and replace with new material components which have been damaged by this or other contracts, including finish, beyond successful repair, as directed by Engineer.

Immediately before Work is turned over to the Owner thoroughly clean all stainless steel doors and frames inside and out. Demonstrate proper cleaning methods to the Owner's maintenance personnel during this final cleaning.

At the completion of the Work, clean or replace adjacent work, marred by the Work of this Section.

Remove all materials and debris and leave the site of the Work in clean condition.

Final Adjustments: Check and readjust operating finish hardware items in stainless steel doors and frames Work just prior to Final Inspection. Leave Work in complete and proper operating conditions.

Protection: Protect installed stainless steel doors and frames during the remainder of the construction, including polycarbonate plastic, against damage from other construction activities, and the Work of other Contractors, by carefully boxing or crating frames and covering doors with reinforced building paper. Remove protection when all danger in doors and frames has passed.

All doors and frames shall be in perfect operating condition with no surface defects of any kind at time of Final Acceptance.

-- End of Section --

SECTION 08700

BUILDERS' HARDWARE
03/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 283	(1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen
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BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA L & R Directory	(Effective thru Jun 1999) Directory of Certified Locks & Latches
BHMA Closer Directory	(Effective thru Jul (1999) Directory of Certified Door Closers
BHMA Exit Devices Directory	(Effective thru Aug 1998) Directory of Certified Exit Devices
BHMA A156.1	(1997) Butts and Hinges
BHMA A156.3	(1994) Exit Devices
BHMA A156.4	(1992) Door Controls - Closers
BHMA A156.6	(1994) Architectural Door Trim
BHMA A156.7	(1997) Template Hinge Dimensions
BHMA A156.8	(1994) Door Controls - Overhead Stops and Holders
BHMA A156.13	(1994) Mortise Locks & Latches
BHMA A156.15	(1995) Closer Holder Release Devices
BHMA A156.16	(1989) Auxiliary Hardware
BHMA A156.18	(1993) Materials and Finishes
BHMA A156.19	(1997) Power Assist and Low Energy Power Operated Doors

DOOR AND HARDWARE INSTITUTE (DHI)

DHI Locations for CSD	(1997) Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames
DHI Locations for SSD	(1990) Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames
DHI ANSI/DHI A115.1G	(1994) Installation Guide for Doors and Hardware

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(1997; Errata 97-1; TIA-97-1) Life Safety Code
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Exit Devices; G|WA
Drawings; G|WA

Detail drawings for hardware demonstrate proper function of units.

SD-03 Product Data

Exit Device Accessories; G|WA

Manufacturer's descriptive data, technical literature, catalog cuts, and installation instructions. Spare parts data for locksets, exit devices, and closers, after approval of the detail drawings, and not later than 1 month(s) prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

Hardware Schedule; G|WA

Hardware schedule listing all items to be furnished. The schedule shall include for each item: the quantities; manufacturer's name and catalog numbers; the ANSI number specified, sizes; detail information or catalog cuts; finishes; door and frame size and materials; location and hardware set identification cross-references to drawings; corresponding reference standard type number or function number from manufacturer's catalog if not covered by ANSI or BHMA; and list of abbreviations and template numbers.

SD-07 Certificates

Hardware and Accessories; G|WA

The hardware manufacturer's certificates of compliance stating that the supplied material or hardware item meets specified requirements. Each certificate shall be signed by an official authorized to certify in behalf of the product manufacturer and shall identify quantity and date or dates of shipment or delivery to which the certificates apply. A statement that the proposed hardware items appear in BHMA L & R Directory, BHMA Closer Directory and BHMA Exit Devices Directory directories of certified products may be submitted in lieu of certificates.

1.3 DELIVERY, STORAGE, AND HANDLING

Hardware shall be delivered to the project site in the manufacturer's original packages. Each article of hardware shall be individually packaged in the manufacturer's standard commercial carton or container, and shall be properly marked or labeled to be readily identifiable with the approved hardware schedule. Manufacturer's printed installation instructions, fasteners, and special tools shall be included in each package.

1.4 SPECIAL TOOLS

Special tools, such as those supplied by the manufacturer, unique wrenches, and dogging keys, shall be provided as required to adjust hardware items.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

1.6 OPERATION AND MAINTENANCE MANUALS

Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides shall be provided.

PART 2 PRODUCTS

2.1 GENERAL HARDWARE REQUIREMENTS

Hardware shall conform to the requirements specified herein and the HARDWARE SETS listing at the end of this section. Hardware set numbers correspond to the set numbers shown on the drawings.

2.2 TEMPLATES

Requirements for hardware to be mounted on metal doors or metal frames shall be coordinated between hardware manufacturer and door or frame manufacturer by use of templates and other information to establish location, reinforcement required, size of holes, and similar details. Templates of hinges shall conform to BHMA A156.7.

2.3 HINGES

Hinges shall conform to BHMA A156.1. Hinges used on metal doors and frames shall also conform to BHMA A156.7. Except as otherwise specified, hinge sizes shall conform to the hinge manufacturer's printed recommendations.

2.3.1 Contractor's Option

Hinges with antifriction bearings may be furnished in lieu of ball bearing hinges, except where prohibited for fire doors by the requirements of NFPA 80.

2.4 LOCKS AND LATCHES

To the maximum extent possible, locksets, latchsets and deadlocks, and all components thereof, including cylinders and removable cores, shall be the products of a single manufacturer. Lock fronts for double-acting doors shall be rounded. Strikes for wood frames and pairs of wood doors shall be furnished with wrought boxes.

2.4.1 Mortise Lock and Latchsets

Mortise lock, latchsets, and strikes shall be series 1000 and shall conform to BHMA A156.13, operational Grade 1. Strikes for security doors shall be rectangular without curved lip. Mortise type locks and latches for doors 1-3/4 inches thick and over shall have adjustable bevel fronts or otherwise conform to the shape of the door. Mortise locks shall have armored fronts.

2.4.2 Auxiliary Locks and Associated Products

Bored and mortise dead locks and dead latches, narrow style dead locks and dead latches, rim latches, dead latches, and dead bolts, and electric strikes shall conform to BHMA A156.5. Bolt and latch retraction shall be dead bolt style. Strike boxes shall be furnished with dead bolt and latch strikes for Grade 1.

2.5 EXIT DEVICES AND EXIT DEVICE ACCESSORIES

Exit devices and exit device accessories shall conform to BHMA A156.3, Grade 1.

2.5.1 Exit Devices and Auxiliary Items

Trim shall be of wrought construction and commercial plain design with straight, beveled, or smoothly rounded sides, corners, and edges. Adjustable strikes shall be provided for rim type and vertical rod devices. Open back strikes shall be provided for pairs of doors with mortise and vertical rod devices; except open back strikes shall be used on labeled doors only where specifically provided for in the published listings. Touch bars may be provided in lieu of conventional crossbars and arms. Escutcheons shall be provided not less than 7 by 2-1/4 inches. Escutcheons shall be cut to suit cylinders and operating trim.

2.5.2 Door Coordinator

Door coordinator with carry bar shall be Type 21 and shall be provided for each pair of doors equipped with an overlapping astragal. The coordinator may be mechanically operated and shall be capable of holding the active door of a pair open until the inactive door has preceded it in the closing cycle. When used as fire exit hardware, the coordinator and carry bar shall be listed or labeled by a nationally recognized independent testing laboratory.

2.5.3 Automatic Flush Bolts

Automatic flush bolts shall be Type 25 in accordance with BHMA A156.3, and shall be installed at the top and bottom of the inactive leaf of pairs of fire rated doors where specified in the hardware sets. Flush bolts shall be mortised in the strike edge of the door.

2.6 DOOR CLOSING DEVICES

Door closing devices shall conform to BHMA A156.4, Grade 1. Closing devices shall be products of one manufacturer for each type specified. The opening resistance of closing devices shall not exceed 15 lbf applied at the latch stile or exceed 5 lbf where low opening resistance is scheduled.

2.6.1 Surface Type Closers

Surface type closers shall be Grade 1, Series C02000 Full Cover with options PT-4H, Size 1 or 2 through Size 6, and PT-4D with back check position valve.

2.7 DOOR CONTROLS - OVERHEAD HOLDERS

Door controls - overhead holders shall conform to BHMA A156.8.

2.8 ARCHITECTURAL DOOR TRIM

Architectural door trim shall conform to BHMA A156.6.

2.8.1 Door Protection Plates

2.8.1.1 Kick Plates

Kick plates shall be Type J102 stainless steel. Width of plates shall be 2 inches less than door width for single doors and 1 inch less for pairs of doors. Height shall be 16 inches. Edges of metal plates shall be beveled.

2.8.2 Push Plates

2.8.2.1 Combination Push-Pull Plates

Combination push-pull plates shall be Type J303, 0.050 inch thick minimum stainless steel beveled four edges.

2.8.3 Door Pulls and Push/Pull Units

2.8.3.1 Arm Pulls

Arm pulls shall be Category J400, double base, stainless steel.

2.9 AUXILIARY HARDWARE

Auxiliary hardware, consisting of door holders, door stops, and roller latches, shall conform to BHMA A156.16. Lever extension flush bolts shall be Type L14081. Dust-proof strikes shall be Type L04011 for doors that are not fire rated. Other auxiliary hardware of the types listed below, shall conform to BHMA A156.16.

2.10 FASTENINGS

Fastenings of proper type, size, quantity, and finish shall be supplied with each article of hardware. Machine screws and expansion shields shall

be used for attaching hardware to concrete or masonry. Sex bolts, through bolts, or machine screws and grommet nuts, where used on reverse-bevel exterior doors equipped with half-surface or full-surface hinges, shall employ one-way screws or other approved tamperproof screws. Screws for the jamb leaf of half-mortise and full-surface hinges attached to structural steel frames shall be one-way or other approved tamperproof type.

2.11 FINISHES

Unless otherwise specified, finishes shall conform to those identified in BHMA A156.18. Where painting of primed surfaces is required, painting is specified in Section 09900 PAINTING, GENERAL.

PART 3 EXECUTION

3.1 APPLICATION

Hardware shall be located in accordance with DHI Locations for CSD and DHI Locations for SSD, except that deadlocks shall be mounted 48 inches above finish floor. When approved, slight variations in locations or dimensions will be permitted. Application shall be in accordance with DHI ANSI/DHI A115.1G or DHI ANSI/DHI A115-W. Door control devices for exterior doors such as closers and holders, shall be attached to doors with thru bolts and nuts or sex bolts. Alternate fastening methods may be approved by the Contracting Officer when manufacturers' documentation is submitted to verify that the fastening devices and door reinforcements are adequate to resist wind induced stresses. Electric hardware items and access control devices shall be installed in accordance with manufacturer's printed installation procedures.

3.1.1 Door-Closing Devices

Door-closing devices shall be installed and adjusted in accordance with the templates and printed instructions supplied by the manufacturer of the devices. Insofar as practicable, doors opening to or from halls and corridors shall have the closer mounted on the room side of the door.

3.1.2 Kick Plates

Kick plates shall be installed on both sides of doors.

3.1.3 Auxiliary Hardware

Lever extension flush bolts shall be installed at the top and bottom of the inactive leaf of pairs of doors. The bottom bolt shall operate into a dust-proof floor strike or threshold.

3.2 FIELD QUALITY CONTROL

Supplier shall inspect the completed installation and certify that the hardware has been furnished and installed in accordance with the manufacturers' instructions [and as specified]. The inspection report shall identify any malfunctioning items and recommend adjustment or replacement as appropriate.

-- End of Section --

SECTION 09900

PAINTING, GENERAL
07/92

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH Limit Values	(1999) Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 150	(1998a) Portland Cement
ASTM D 4214	(1998) Evaluating Degree of Chalking of Exterior Paint Films
ASTM D 4258	(1999) Surface Cleaning Concrete for Coating

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1500	(Rev A; Notice 1) Sealer, Surface (Latex Block Filler)
CID A-A-2246	(Rev B) Paint, Latex
CID A-A-2247	(Basic) Paint, Latex (Semigloss, Interior)
CID A-A-2248	(Basic) Paint, Latex, (Flat, Interior)
CID A-A-2867	Coating, Polyurethane, Single Component Moisture Cure, Aliphatic
CID A-A-2962	(Rev A) Enamel, Alkyd (Metric)
CID A-A-2994	Primer Coating, Interior, for Walls and Wood

FEDERAL SPECIFICATIONS (FS)

FS TT-E-2784	(Rev A) Enamel (Acrylic-Emulsion, Exterior Gloss and Semigloss) (Metric)
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THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 5	(1995) Zinc Dust, Zinc Oxide and Phenolic Varnish Paint
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SSPC Paint 23	(1991) Latex Primer for Steel surfaces
SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)
SSPC SP 1	(1982) Solvent Cleaning
SSPC SP 2	(1995) Hand Tool Cleaning
SSPC SP 3	(1995) Power Tool Cleaning
SSPC SP 6/NACE 3	(1994) Commercial Blast Cleaning
SSPC SP 7/NACE 4	(1994) Brush-Off Blast Cleaning

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Paint; G|WA

The names, quantity represented, and intended use for the proprietary brands of materials proposed to be substituted for the specified materials regardless of quantities in states where VOC content limitations apply. Submit color charts for final color selection.

Mixing and Thinning; FIO
Application; FIO

Manufacturer's current printed product description, material safety data sheets (MSDS) and technical data sheets for each coating system. Detailed mixing, thinning and application instructions, minimum and maximum application temperature, and curing and drying times between coats for epoxy, moisture-curing polyurethane, and liquid glaze coatings. Detailed application instructions for textured coatings shall be provided.

SD-04 Samples

Paint; FIO

While the material is at the site or source of supply, and at a time agreeable to the Contractor and the Contracting Officer, a 1 quart sample of each color and batch, except for quantities of 50 gallons or less, shall be taken by random selection from the sealed containers by the Contractor in the presence of a representative of the Contracting Officer. The contents of the containers to be sampled shall be thoroughly mixed to ensure that the sample is representative. Samples shall be identified by designated name, specification number, manufacturer name and

address, batch number, project contract number, intended use, and quantity involved.

SD-06 Test Reports

Paint; G|WA

A statement as to the quantity represented and the intended use, plus the following test report for batches in excess of 50 gallons:

a. A test report showing that the proposed batch to be used meets specified requirements:

b. A test report showing that a previous batch of the same formulation as the batch to be used met specified requirements, plus, on the proposed batch to be used, a report of test results for properties of weight per gallon, viscosity, fineness of grind, drying time, color, and gloss.

SD-07 Certificates

Lead; FIO

Mildewcide and Insecticide; FIO

Volatile Organic Compound (VOC) Content; FIO

Certificate stating that paints for interior use contain no mercurial mildewcide or insecticide. Certificate stating that paints proposed for use contain not more than 0.06 percent lead by weight of the total nonvolatile. Certificate stating that paints proposed for use meet Federal VOC regulations and those of the of the local Air Pollution Control Districts having jurisdiction over the geographical area in which the project is located.

1.3 PACKAGING, LABELING, AND STORING

Paints shall be in sealed containers that legibly show the designated name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons.

Paints and thinner shall be stored in accordance with the manufacturer's written directions and as a minimum stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors and at temperatures between 40 and 95 degrees F. Paints shall be stored on the project site or segregated at the source of supply sufficiently in advance of need to allow 30 days for testing.

1.4 APPROVAL OF MATERIALS

When samples are tested, approval of materials will be based on tests of the samples; otherwise, materials will be approved based on test reports furnished with them. If materials are approved based on test reports furnished, samples will be retained by the Government for testing should the materials appear defective during or after application. In addition to any other remedies under the contract the cost of retesting defective materials will be at the Contractor's expense.

1.5 ENVIRONMENTAL CONDITIONS

Unless otherwise recommended by the paint manufacturer, the ambient temperature shall be between 45 and 95 degrees F when applying coatings other than water-thinned, epoxy, and moisture-curing polyurethane coatings.

Water-thinned coatings shall be applied only when ambient temperature is between 50 and 90 degrees F. Epoxy, and moisture-curing polyurethane coatings shall be applied only within the minimum and maximum temperatures recommended by the coating manufacturer. Moisture-curing polyurethane shall not be applied when the relative humidity is below 30 percent.

1.6 SAFETY AND HEALTH

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in the CONTRACT CLAUSES. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.6.1 Worker Exposures

Exposure of workers to hazardous chemical substances shall not exceed limits established by ACGIH Limit Values, or as required by a more stringent applicable regulation.

1.6.2 Toxic Compounds

Toxic products having ineffective physiological warning properties, such as no or low odor or irritation levels, shall not be used unless approved by the Contracting Officer.

1.6.3 Training

Workers having access to an affected work area shall be informed of the contents of the applicable material data safety sheets (MDSS) and shall be informed of potential health and safety hazard and protective controls associated with materials used on the project. An affected work area is one which may receive mists and odors from the painting operations. Workers involved in preparation, painting and clean-up shall be trained in the safe handling and application, and the exposure limit, for each material which the worker will use in the project. Personnel having a need to use respirators and masks shall be instructed in the use and maintenance of such equipment.

1.6.4 Coordination

Work shall be coordinated to minimize exposure of building occupants, other Contractor personnel, and visitors to mists and odors from preparation, painting and clean-up operations.

PART 2 PRODUCTS

2.1 PAINT

The term "paint" as used herein includes emulsions, enamels, paints, stains, varnishes, sealers, cement-emulsion filler, and other coatings, whether used as prime, intermediate, or finish coat. Paint shall conform to the requirements listed in the painting schedules at the end of this section, except when the required amount of a material of a particular batch is 50 gallons or less, an approved first-line proprietary paint material with similar intended formulation, usage and color to that specified may be used. Additional requirements are as follows:

2.1.1 Colors and Tints

Colors shall be as selected from manufacturer's standard colors, as indicated. Manufacturer's standard color is for identification of color only. Tinting of epoxy and urethane paints shall be done by the manufacturer. Stains shall conform in shade to manufacturer's standard color. The color of the undercoats shall vary slightly from the color of the next coat.

2.1.2 Lead

Paints containing lead in excess of 0.06 percent by weight of the total nonvolatile content (calculated as lead metal) shall not be used.

2.1.3 Chromium

Paints containing zinc chromate or strontium chromate pigments shall not be used.

2.1.4 Volatile Organic Compound (VOC) Content

Paints shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards and shall conform to the restrictions of the local air pollution control authority.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS NOT TO BE PAINTED

Items not to be painted which are in contact with or adjacent to painted surfaces shall be removed or protected prior to surface preparation and painting operations. Items removed prior to painting shall be replaced when painting is completed. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Surfaces contaminated by coating materials shall be restored to original condition.

3.2 SURFACE PREPARATION

Surfaces to be painted shall be clean and free of foreign matter before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.2.1 Concrete, Stucco and Masonry Surfaces

Concrete, stucco and masonry surfaces shall be allowed to dry at least 30 days before painting, except concrete slab on grade which shall be allowed to cure 90 days before painting. Surfaces shall be cleaned in accordance with ASTM D 4258. Glaze, efflorescence, laitance, dirt, grease, oil, asphalt, surface deposits of free iron and other foreign matter shall be removed prior to painting. Surfaces to receive polyurethane or epoxy coatings shall be acid-etched or mechanically abraded as specified by the coating manufacturer, rinsed with water, allowed to dry, and treated with the manufacturer's recommended conditioner prior to application of the first coat.

3.2.2 Ferrous Surfaces

Ferrous surfaces including those that have been shop-coated, shall be solvent-cleaned or detergent-washed in accordance with SSPC SP 1. Surfaces that contain loose rust, loose mill scale, and other foreign substances shall be cleaned mechanically with hand tools according to SSPC SP 2, power tools according to SSPC SP 3 or by sandblasting according to SSPC SP 7/NACE 4. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

3.2.3 Nonferrous Metallic Surfaces

Galvanized, aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces shall be solvent-cleaned or detergent-washed in accordance with SSPC SP 1.

3.2.4 Previously Painted Surfaces

Previously painted surfaces shall be thoroughly cleaned of all grease, dirt, dust or other foreign matter. Blistering, cracking, flaking and peeling or other deteriorated coatings shall be removed. Slick surfaces shall be roughened. Damaged areas such as, but not limited to, nail holes, cracks, chips, and spalls shall be repaired with suitable material to match adjacent undamaged areas. Edges of chipped paint shall be feather edged and sanded smooth. Rusty metal surfaces shall be cleaned as per SSPC requirements. Solvent, mechanical, or chemical cleaning methods shall be used to provide surfaces suitable for painting. Chalk shall be removed so that when tested in accordance with ASTM D 4214, the chalk resistance rating is no less than 8. New, proposed coatings shall be compatible with existing coatings. If existing surfaces are glossy, the gloss shall be reduced.

3.3 MIXING AND THINNING

When thinning is approved as necessary to suit surface, temperature, weather conditions, or application methods, paints may be thinned in accordance with the manufacturer's directions. When thinning is allowed, paints shall be thinned immediately prior to application with not more than 1 pint of suitable thinner per gallon. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

3.3.1 Cement-Emulsion Filler Coat

Cement and aggregate shall be dry-mixed so that uniform distribution and intermixing are obtained. Mixing liquid and one-half of the total amount of water shall be premixed and added gradually to the white portland cement and aggregate with constant stirring until a thick, smooth material is obtained. Emulsion paint shall then be added to the mixture and stirred until uniformity is obtained. The blend shall have a thick, creamy consistency. The remainder of the water shall be added if necessary to obtain a material with adequate application properties. Blending resin emulsion or emulsion paint with any other component shall be done with caution; too rapid an agitation will cause air entrapment and foaming.

3.3.2 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

3.4 APPLICATION

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application. Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces. Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

3.4.1 Ventilation

Affected areas shall be ventilated during paint application so that workers exposure to chemical substances shall not exceed limits as established by ACGIH Limit Values, or as required by a more stringent applicable regulation. Interior work zones having a volume of 10,000 cubic feet or less shall be ventilated at a minimum of 2 air exchanges per hour. Ventilation in larger work zones shall be maintained by means of mechanical exhaust. Solvent vapors shall be exhausted outdoors, away from air intakes and workers. Return air inlets in the work zone shall be temporarily sealed before start of work until the coatings have dried.

3.4.2 Respirators

Operators and personnel in the vicinity of operating paint sprayers shall wear respirators.

3.4.3 First Coat

The first coat on plaster, gypsum wallboard, and other surfaces shall include repeated touching up of suction spots or overall application of

primer or sealer to produce uniform color and gloss. Excess sealer shall be wiped off after each application.

3.4.4 Timing

Surfaces that have been cleaned, pretreated, and otherwise prepared for painting shall be given a coat of the specified first coat as soon as practical after such pretreatment has been completed, but prior to any deterioration of the prepared surface. Sufficient time shall elapse between successive coats to permit proper drying. This period shall be modified as necessary to suit weather conditions. Oil-based or oleoresinous solvent-type paints shall be considered dry for recoating when the paint feels firm, does not deform or feel sticky under moderate pressure of the thumb, and the application of another coat of paint does not cause the undercoat to lift or lose adhesion. Manufacturer's instructions for application, curing and drying time between coats of two-component systems shall be followed.

3.4.5 Fillers

Concrete and masonry surface voids shall be filled; however, surface irregularities need not be completely filled. The dried filler shall be uniform and free of pinholes. Filler shall not be applied over caulking compound.

3.4.5.1 Cement-Emulsion Filler

Immediately before filler application, surfaces shall be dampened uniformly and thoroughly, with no free surface water visible, by several applications of potable water with a fog spray, allowing time between the sprayings for water to be absorbed. Cement-emulsion filler shall be scrubbed into the surface vigorously with a stiff-bristled brush having tampico or palmyra bristles not longer than 2-1/2 inches. At least 24 hours shall elapse before applying exterior emulsion paint over cement-emulsion filler. When the ambient temperature is over 85 degrees F, cement-emulsion filler surfaces shall be dampened lightly with a fog spray of potable water immediately prior to application of the subsequent paint coat.

3.4.5.2 Latex Filler

Latex filler, CID A-A-1500, shall be applied according to the manufacturer's instructions. Surface voids shall be filled and excess filler shall be removed from the surface with a rubber squeegee. The filler shall be allowed to dry the length of time specified by the manufacturer prior to applying successive coats of paint.

3.4.6 Ferrous-Metal Primer

Primer for ferrous-metal shall be applied to ferrous surfaces to receive paint other than asphalt varnish prior to deterioration of the prepared surface. The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.

3.5 PIPE COLOR CODE MARKING

Pipes in exposed areas and in accessible pipe spaces shall be provided with color band and titles adjacent to all valves, except those provided at plumbing fixtures, at not more than 40 foot spacing on straight pipe runs,

adjacent to change in direction, and on both sides where pipes pass through walls or floors. Color code marking shall be of the color listed in TABLE I and the size listed in TABLE II. The arrows shall be installed adjacent to each band to indicate the direction of flow in the pipe. The legends shall be printed in upper-case black letters as listed in TABLE I. Letter sizes shall be as listed in TABLE II. Marking shall be painted or applied using colored, pressure-sensitive adhesive markers of standard manufacture. Paint shall be as specified for insulated and uninsulated piping.

TABLE I. COLOR CODES FOR MARKING PIPE

Material	Color	Band	Letters and Arrow*	Legend
Filter Influent	Aqua	N/A	N/A	
Filter Effluent	Federal Safety Blue	N/A	N/A	
Filter Backwash Supply	Medium Blue	N/A	N/A	
Filter Drain	Light Brown	N/A	N/A	
Filter to Waste	Brown	Black	Yellow	F.T.W.

TABLE II. COLOR CODE MARKING SIZES

Outside Diameter of Pipe Covering (Inches)	Length of Color Band (inches)	Arrow Length x Width (Inches)	Size of Legend Letters and Numerals (Inches)
Less than 1-1/2	8	8 x 2-1/4	1/2
1-1/2 to 2-3/8	8	8 x 2-1/4	3/4
2-1/2 to 7-7/8	12	8 x 2-1/4	1-1/4
8 to 10	24	12 x 4-1/2	2-1/2
Over 10	32	12 x 4-1/2	3-1/2

3.6 MISCELLANEOUS PAINTING

3.6.1 Lettering

Filter numbers shall be provided on the filter drain pipe at each filter. Lettering shall be block type, approximately 4 inches in height, and shall be black enamel. Samples shall be approved before application.

3.7 SURFACES TO BE PAINTED

Surfaces listed in the painting schedules at the end of this section, other than those listed in paragraph SURFACES NOT TO BE PAINTED, shall be painted as scheduled.

3.8 SURFACES NOT TO BE PAINTED

Concrete walls, ceiling, columns, insulated piping, FRP items, and conduit shall not be painted.

3.9 CLEANING

Cloths, cotton waste and other debris that might constitute a fire hazard shall be placed in closed metal containers and removed at the end of each day. Upon completion of the work, staging, scaffolding, and containers shall be removed from the site or destroyed in an approved manner. Paint and other deposits on adjacent surfaces shall be removed and the entire job

left clean and acceptable.

3.10 PAINTING SCHEDULES

The following painting schedules identify the surfaces to be painted and prescribe the paint to be used and the number of coats of paint to be applied. Contractor options are indicated by -----or----- between optional systems or coats.

EXTERIOR PAINTING SCHEDULE

<u>Surface</u>	<u>First Coat</u>	<u>Second Coat</u>
New and Existing Concrete Unit Masonry Walls; Non-submerged Interior	Minimum 64 percent volume solids, high- build, two-component, polyamide-catalyzed epoxy block filler, recommended by manufacturer for providing adhesion to constantly damp surfaces; containing 2.50 pounds per gallon VOC, maximum. One coat, 10.0 dry mils, 75-100 square feet per gallon.	Minimum 56 percent volume solids high- build, two-component, polyamide-catalyzed epoxy; containing 3.40 pounds per gallon VOC, maximum. Two coats, 3.0 to 5.0 dry mil per coat, 140-240 square feet per gallon per coat.
Ferrous Metals, Miscellaneous Ferrous Metals, Exterior Surfaces of Valves, Exterior Surfaces of Ferrous Piping; Non- submerged, Interior	Minimum 56 percent volume solids, high-build, two- component, polyamide- catalyzed epoxy; con- taining 3.40 pounds per gallon VOC, maximum. Two coats, 1.5 to 2.5 dry mils per coat, 280-475 square feet per gallon per coat.	Minimum 80 percent volume solids, high- build, two-component, cycloaliphatic amine- catalyzed epoxy coating, recommended by manufacturer for providing long-term chemical and corrosion protection; containing 1.55 pounds per gallon VOC, maximum. Two coats, 6.0 to 8.0 dry mils per coat, 130-175 square feet per gallon per coat.
New and Existing Galvanized Metal, Non-Ferrous Metal; Non-submerged,	Minimum 56 percent volume solids, high- build, two-component, polyamide-catalyzed	Minimum 80 percent volume solids, high- build, two-component, cycloaliphatic amine-

EXTERIOR PAINTING SCHEDULE

<u>Surface</u>	<u>First Coat</u>	<u>Second Coat</u>
Interior	epoxy; containing 3.40 pounds per gallon VOC, maximum. One coat, 2.0 to 3.0 dry mils, 240-360 square feet per gallon.	catalyzed epoxy coating, recommended by manufacturer for providing long-term chemical and corrosion protection; containing 1.55 pounds per gallon VOC, maximum. Two coats, 4.0 to 6.0 dry mils per coat, 175-260 square feet per gallon per coat.

-- End of Section --